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SOME CHEMOTROPIC AND FEEDING REACTIONS OF PLANARIA MACULATA.

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California.)

When a hungry¹ Planarian is placed in a finger-bowl of water a piece of liver has been lying for some minutes, the worm moves about the dish until it enters the diffusing meat-juice. It pauses at once and extrudes the pharynx. This waves about for a few seconds and is withdrawn. Then the worm takes up its course directly toward the meat and, reaching it, begins feeding. The same reaction is seen when the worm is gliding on the surface film and a bit of egg-yolk is floated near it. This preliminary extrusion of the pharynx, although regularly appearing when hungry worms first come into contact with meat-juice, is very transitory. It does not occur again if the worm leaves the juice and reënters it on its way to the meat or if it is placed in an extract of meat and left to wander about there.

If, however, a section is made through the worm behind the cephalic lobes and anterior to the pharynx the result differs. Directly after the cut the worms move about in an active manner though they eventually come to rest. If while still moving they enter a region of diffusing meat-juice they often stop. The pharynx is extended and remains so; feeding begins upon the juice itself and may continue until the body has swollen and become lighter colored as in ordinary feeding. Often the reaction is not so prolonged but it is always more free and persistent than in uncut worms. From this a natural inference would be that such pieces placed directly upon meat would respond with the feeding reaction, and this is true. The posterior portion of any hungry worm will feed when placed upon a fresh piece of liver.

¹ Worms which had been fasting several weeks were used for these reactions. Well-nourished worms do not furnish good material, as their sensitivity to chemical stimulation is low compared to that of fasting worms.

This result is contrary to that of Pearl,¹ and more extended than that of Bardeen.²

A certain degree of independent activity on the part of the pharynx is thus indicated. The same thing could be suspected from the feeding reaction of normal worms. Often a normal worm will come to rest side by side but not in contact with a piece of meat. The pharynx will be extruded and directed toward the meat and will stretch out to reach it to such a degree that the portion of the body to which the pharynx is attached will be pulled out of place, making an indentation on the dorsal surface of the worm. The worm itself will not move at all to help the pharynx, whereas if the pharynx were not extended the chemotropic reaction of the whole worm would carry it directly up to the meat.

There seems to be a twofold chemotropic response, that manifested by the movement of the whole worm toward the meat and that manifested by the movement of the pharynx. Both responses are accurately directed, but when the one is active the other is apparently inhibited. Thus when the stimulation is comparatively weak, the sensitive cells of the skin respond in such a manner that the worm moves directly toward the meat and ordinarily the pharyngeal reflex is entirely in abeyance. When, however, the stimulation is very strong, as upon direct contact with meat or upon the first contact of a very hungry worm with meat-juice, the pharyngeal reflex dominates for a longer or shorter time. When the anterior end of the worm is removed, with it are taken away those portions of the skin which are most sensitive to chemical stimulus. Now a weak stimulus, as that of diffusing juice, calls forth a more pronounced pharyngeal response as though some inhibition were removed.

Some independent chemotropic response seemed so certainly to be located in the pharynx that the question of the activity of the isolated pharynx was raised. If a section is made through the anterior extremity of the pharyngeal sac gentle pressure will force out the pharynx which is now entirely separate from the body. It must be observed that pharynxes so prepared vary as much in sensitivity as do the worms from which they

¹ Pearl, R., *Quarterly Journal of Microscopical Science*, 1902-3, Vol. 46, p. 509.

² Bardeen, C. R., *American Journal of Physiology* (1901), Vol. 5, p. 1.

are extracted. But given a sensitive preparation of which any number can be obtained the reaction is as follows: When placed in a dish of water close to a piece of liver, the pharynx elongates actively, its delicate lip is extended into a broad funnel, the walls of which undulate constantly, receiving and being directed by the stimulating substances of the meat-juice. The result is that the funnel is pointed toward the meat, and not only so but the whole pharynx moves forward sometimes several millimeters by a very wormlike series of extensions, contractions and wriggings until the mouth comes into direct contact with the meat. There is no doubt of the power of the pharynx to orient itself toward the source of diffusing juice and its ability to move toward that source.

The feeding reaction of the pharynx upon reaching the meat is of enough interest to deserve description. Contact of the mouth with the meat causes a wave of peristalsis to pass almost instantly through the pharynx and as a result a mass of food is discharged from the end of the pharynx to which the intestine would normally be attached. Other waves follow in quick succession and the consumed food is discharged at each wave with considerable force. This activity continues for many minutes and results in the accumulation of a surprisingly large heap of food. The shape of the passage through the pharynx is more or less maintained by the masses of food and the little strings of food particles show a tenacity which indicates that the pharynx has added a secretion probably of a mucous nature to the substance passing through it. The experiment can be duplicated with liver extract or yolk of egg dropped carefully on to the bottom of a dish containing water. The pharynx will work its way into the substance and move sometimes a considerable distance in irregular course through it. During the movement it is constantly eating and leaving behind a trail of consumed food. While this reaction is in progress the pharynx bears a remarkable resemblance to a whole organism. The casual observer would immediately call it a living worm. Such entire maintenance of function by an isolated organ is certainly unusual.